

# SOIL SURVEY OF WASHINGTON COUNTY, PENNSYLVANIA.

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## DESCRIPTION OF THE AREA.

Washington County is one of the westernmost range of counties in southwestern Pennsylvania. It is bounded on the north by Beaver and Allegheny Counties; on the east by the Monongahela River and Allegheny County; on the south by Greene County; and on the west by the State of West Virginia. It embraces 569,600 acres or 890 square miles. From north to south the county has a length of approximately 36 miles, while in an east and west direction its width varies from about 36 miles in the southern part to 12 miles in the extreme north.

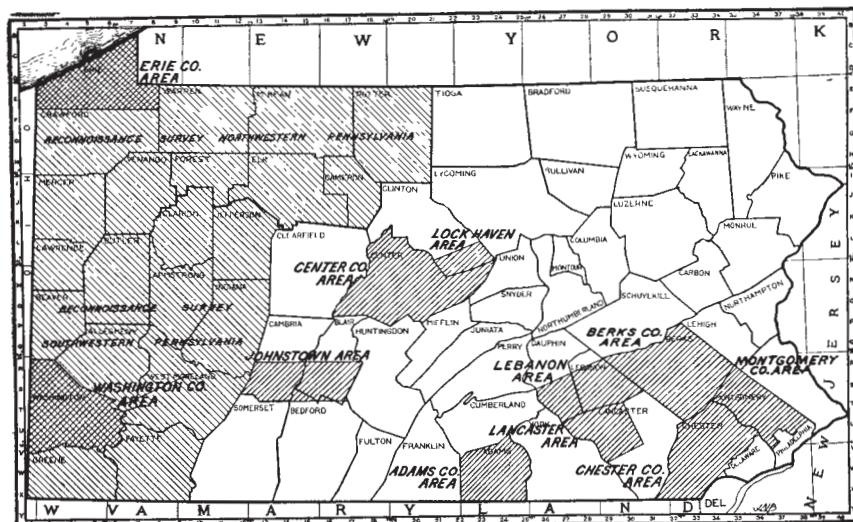


FIG. 7.—Sketch map showing location of the Washington County area, Pennsylvania.

The topography of the county ranges from rolling to hilly. The valley of the Monongahela River, in the eastern part of the county, is the most conspicuous topographic feature. It is comparatively narrow and gorge-like and meanders in a northerly direction, forming the greater part of the eastern boundary of the county. Bordering the river are narrow bottom lands seldom more than a quarter of a mile in width, and frequently much less, found now on one side of the river and now on the other.

From these bottom lands hills rise abruptly to a height of from 200 to 350 feet, and from their summits the country stretches away westward in fine rolling uplands, which might in some cases be called hilly. On the tops of these hills, or occupying shelflike positions on them, occur a few old river terraces, formed before the river had cut such a deep channel.

In the western part of the county the drainage is into the Ohio Basin. Here, as along the Monongahela and its tributaries, one finds much of the same kind of country. There are narrow bottom lands, or in some cases none, for the valley floors are frequently too narrow to admit of much sedimentation. From the stream beds arise hills, more or less steep, and from these the country rises to rolling uplands or hills. It is in reality an ancient upland plateau, which has been altered and dissected by years of weathering and erosion. It consists of a number of hills and peaks, the highest points of which are nearly on the same level. The elevation throughout the county ranges from 1,000 to 1,500 feet above sea level.

In general throughout the county the hills are tillable to their summits, but in some places, especially along the larger streams, they are so steep that crops can only be sowed and gathered by hand. In the extreme southwest corner of the area there is very little bottom land along the streams, the hills rise very abruptly, and the highlands are very steep and rugged.

The area embraces the divide between the Ohio and Monongahela Basins. In the east the Monongahela River flows north, while its tributaries draining the eastern part of the county flow in an easterly and northeasterly direction. In the western half of the county Enslow Fork of Wheeling Creek, Buffalo, Cross, and Kings Creeks flow west, in roughly parallel courses, to the Ohio River. Raccoon Creek, in the northern part of the county, has a course nearly due north.

The streams, as a rule, meander back and forth over the narrow valley floors in large loops. It is in these loops that the rich alluvial land of the area is found. This is perhaps the greatest in extent along Chartiers Creek, where occasionally small second terraces are found, the result of sedimentation at some previous time, before the stream channel had been cut so deep.

The area was one of the earliest explored west of the Allegheny Mountains and abounds in historical sites. As early as 1720 French traders penetrated the region, then the hunting grounds of various Indian tribes. From this time until 1766 the county was visited by many trappers, traders, and military scouts, among the latter George Washington, who later became the owner of considerable tracts of land in the county. It is in honor of him that the county is named.

In 1776 the first cabins of white men were built along Raccoon Creek and at the mouth of Tenmile Creek. In 1770 a number of colonists settled in the vicinity of Rich Hill, one of the best-known spots in the county, and the same year settlers began moving into Chartiers Valley in increasing numbers.

Washington County was formed in 1781 to include all the land lying west of the Monongahela River in Pennsylvania. Later, however, in 1796 and 1800, Greene and Beaver Counties were taken from it and the county reduced to its present size. Perhaps the greatest aid in opening up the county to settlement and development occurred soon after 1811, when the old National Turnpike was built.

The earliest settlers were of Scotch-Irish extraction, many of them having emigrated from the west of Scotland and the north of Ireland. Other settlers, of German descent, came from Cumberland and York Counties, Pa., and still others of various nationalities came from Virginia. Of the present population a large part, especially the farming element, consists mainly of the descendants of these early settlers. The remainder are recent immigrants from various parts of Europe, who have been attracted by the wages paid in the development of the coal, oil, and gas resources of the county.

The development of these great natural resources has occurred mostly within the last 20 years, and has been responsible for the building and rapid growth of many towns near the seats of these industries. This is especially true along the Monongahela River, where the transportation facilities offered by water and later by railroads caused an earlier and more extensive exploitation of these projects than elsewhere in the county. In such sections interest in these industries has far overshadowed that in farming and has interfered with the development of agriculture.

The principal towns of the area are Washington, which is the county seat, Charleroi, and Monongahela. Other smaller towns, in various sections, of importance as local markets and trading centers, are California, Claysville, Canonsburg, McDonald, and Burgettstown. Each of these towns has a good public-school system and the schools throughout the rural districts are numerous and of a high character. In addition to this, Washington and Jefferson College, located at Washington, offers opportunities for higher education, while transportation facilities are such that the schools of Pittsburgh are accessible.

The Wheeling Division of the Baltimore & Ohio Railroad enters the county in the southern part and runs in a northeastern direction to Pittsburg. The Wabash and Pennsylvania have roughly parallel lines crossing the county in an east and west direction in the central and northern parts, respectively. The Monongahela Division of the Pennsylvania Railroad with its branches runs down the Monongahela

Valley, and with the river itself affords ample transportation facilities for that section of the county.

In addition to these steam roads, the Pittsburg Railway Co. has two fast electric lines which carry passengers, freight, and baggage, and connect Washington and Pittsburg and Pittsburg and Charleroi.

The roads throughout the county are fair and are being improved. Many macadamized and some brick roads are being built by the county and various townships. The value of these roads is especially evident in the wet seasons of the year, when the clay roads become so wet and heavy that the hauling of large loads is impossible. At other times of the year these clay roads are generally good and can easily be kept so by the intelligent use of road drags.

The market facilities of this area are unusual. In nearly every section of the county, except the extreme southwest, there is a good local market of easy access. Besides this, the numerous railroads and electric lines put the markets of Pittsburg, Pa., Wheeling, W. Va., and Steubenville, Ohio, within easy reach of the producer. There is a widely diversified demand in each of these markets for nearly every kind of agricultural product, from truck, fruit, and hot-house delicacies to dairy products and the general farm crops. The prices paid for these articles are excellent and the demand far exceeds the local supply.

#### CLIMATE.

The climate of Washington County is healthful and well suited to the carrying on of general farming. For this type of agriculture the winters should not be too severe, and the rainfall should be sufficient to start the crops in the spring and carry them to maturity.

Records for this area show that the winters, though cold, are not extremely severe. The temperature, while sometimes falling below zero Fahrenheit, seldom remains there for any length of time, and the average normal temperature for December, January, and February, the three coldest months, is about 33° F. There is generally considerable snow during these months, however, the monthly precipitation averaging nearly 3 inches.

The warmest months are June, July, and August, but they are for the most part pleasant and not excessively hot. The thermometer seldom registers more than 95° F. and the average normal temperature for these months is about 71° F.

The average annual rainfall is about 40 inches and is generally equally distributed throughout the year. Sometimes the autumn is somewhat dry, as the least precipitation occurs in September, October, and November, but the average for these months is over 2 inches. The heaviest precipitation occurs in spring and summer. This insures an abundant supply of moisture for the crops, well distributed throughout the growing season.

The last killing frost in the spring usually occurs from the last of April to the middle of May, while the first in the fall generally comes about the middle of October. This gives a growing season of about five and one-half months, while the weather is sufficiently mild to admit of the pasturing of stock for an average period of six and one-half months.

The following tables, prepared from the records of the United States Weather Bureau stations at Claysville, Lock No. 4 on the Monongahela River, and Pittsburg, give the normal monthly and annual temperatures and precipitation, and the dates of the first and last killing frosts at Claysville and Pittsburg:

*Normal monthly and annual temperature and precipitation.*

Months.	Claysville.		Lock No. 4.		Pittsburg.	
	Temper- ature.	Precipi- tation.	Temper- ature.	Precipi- tation.	Temper- ature.	Precipi- tation.
January.....	° F. 31.8	Inches. 2.75	° F. .....	Inches. .....	° F. 31.0	Inches. 2.96
February.....	29.1	2.71	.....	.....	31.9	2.73
March.....	41.7	4.92	.....	.....	40.0	3.13
April.....	49.5	3.66	.....	.....	50.9	2.90
May.....	60.7	3.41	.....	.....	62.5	3.23
June.....	68.8	4.92	.....	.....	70.7	3.71
July.....	72.0	5.13	.....	.....	74.8	4.39
August.....	70.2	3.61	.....	.....	72.8	3.07
September.....	65.6	2.57	.....	.....	66.7	2.48
October.....	51.8	2.59	.....	.....	54.8	2.32
November.....	42.0	1.26	.....	.....	42.8	2.34
December.....	31.9	2.78	.....	.....	34.0	2.77
Annual.....	51.3	40.31	.....	39.44	52.7	36.23

*Dates of first and last killing frosts.*

Years.	Claysville.		Pittsburg.		Years.	Claysville.		Pittsburg.	
	Last in spring.	First in fall.	Last in spring.	First in fall.		Last in spring.	First in fall.	Last in spring.	First in fall.
1900.....	.....	.....	May 5	Nov. 8	1906.....	May 8	Oct. 12	Apr. 24	Oct. 12
1901.....	.....	.....	Apr. 1	Nov. 2	1907.....	May 22	Oct. 9	Apr. 21	Oct. 15
1902.....	.....	.....	Apr. 8	Nov. 9	1908.....	May 3	Oct. 3	Apr. 4	Oct. 13
1903.....	.....	.....	Apr. 5	Oct. 25	1909.....	May 12	Sept. 28	Apr. 11	Oct. 19
1904.....	Apr. 14	Oct. 4	Apr. 21	Oct. 7	1910.....	May 28	Oct. 29	Apr. 28	Oct. 29
1905.....	May 24	Oct. 13	Apr. 19	Oct. 22					

No temperature or frost data were available for the station at Lock No. 4.

While the Pittsburg station is not located within the area, its figures may be taken as approximating conditions in the northern part of the county.

## AGRICULTURE.

Although white men had built their cabins in Washington County as early as 1766, very little farming was done until 1770, when the Chartiers Valley began to be settled.

The first crops raised were of course for home use and consisted of corn, wheat, and rye. The growing of these cereals constituted the main type of farming for many years. At first, during the early settlement of the county, no attempt was made to grow more than enough for home consumption, but as the county became more thickly populated, the acreage of grain was increased, until the supply of corn, wheat, and rye far exceeded the local demands and the farmers sought a means of marketing this excess, which was accomplished by establishing trade relations with the southern colonies, through the Monongahela, Ohio, and Mississippi Rivers. As the grain was rather bulky to handle, mills, run by water power, were erected throughout the county, and often distilleries were erected in connection with them. To these the farmers brought their grain to be ground into flour and their corn and rye to be converted into whisky. The flour and whisky were loaded on rafts and floated down the rivers to the southern markets. It was in defense of this traffic that the so-called Whisky Insurrection broke out in this county in 1791.

By 1835 the continued grain cropping and poor agricultural practices had impoverished the soils to such an extent that the yields obtained were only about one-third of those previously secured, and grain farming became an unprofitable occupation.

In looking for some other means of livelihood several farmers imported some Merino sheep, and these proved well adapted to the county and a profitable investment. The decreased yield of the soil, the opening up of the western grain fields, and especially the success of sheep raising, all contributed to the abandonment of grain farming, until by 1840 or 1845 little was grown.

All attention at this time was turned to sheep raising, and much of the land that had been under cultivation was abandoned and grew up with weeds and brush. The production of wool came to be a very profitable industry, and each farmer prospered in proportion to the number of sheep he kept. Some of the largest flocks made their owners wealthy.

The wool, being nonperishable, easily handled, and in good demand, formed a more acceptable article of trade with the South than the flour. River transportation facilities had been much improved by this time and the wool and its manufactured products were shipped down the river and traded for cotton, sugar, tobacco, and molasses.

The raising of wool-producing sheep continued to be the main agricultural industry for a period of years. Then a number of cir-

cumstances combined to effect a change. The price of wool decreased; farmers who cultivated their old sheep pastures found that they had regained their productiveness; and, finally, the increase in population and the progress in development of the county created a demand for other products. Consequently sheep raising became somewhat unpopular, and although many were still kept throughout the county, nevertheless the industry no longer continued to occupy the important place it formerly had.

In later years several factors have entered to cause still further decline in wool growing. The development of the coal resources has brought into the county a large foreign element, and the dogs kept by them have proved a serious menace to sheep. Large coke ovens, also, erected in some sections, have not only destroyed the vegetation and pasturage, but also effected a deterioration in the quality of the wool raised in those sections.

As the county has progressed in its industrial development, the population and consequently the demand for food products has increased. The building of various railroads, too, has brought the possibility of supplying this demand to many parts of the county previously inaccessible.

Many farmers are now engaged in growing fruit and truck, not only for the local but also for the Pittsburg market. The acreage of corn, oats, and wheat has also increased in the last few years, although some of the farmers are reducing their wheat acreage, saying that they can not profitably produce it in competition with western growers.

If, in the last 20 years, the development of the coal, oil, and gas resources opened opportunities for the marketing of agricultural products, it has also in many ways proved a serious drawback to the advancement of agricultural interests in the county.

The sale of coal, oil, and gas rights has brought considerable wealth to the landowners, and many of them, finding their living assured, have lost all interest in agricultural pursuits, and have either abandoned their farms to tenants or do the farming themselves in a half-hearted, disinterested way. Many of those who have not yet sold these coal and oil rights farm in the same disinterested manner, their only aim apparently being to secure a living until such a time as they can sell these rights at a rate that will enable them to retire from an agricultural life. Such an attitude has very seriously retarded the development of the agricultural possibilities of the county.

On the other hand, there are a number of the more prosperous and intelligent farmers who have wisely invested their coal and gas royalties in farm improvements and are industriously engaged in maintaining their soil fertility and in increasing their crop yields

and who take advantage of the agricultural opportunities open to them. Owing to these conditions there is a wide range of crop yields.

At the present time the chief crop in the county is hay, which finds a ready market in Pittsburg at from \$10 to \$16 a ton. Much of the hay is of poor quality, owing probably to an inability to cut large acreages at the proper time. Corn is the next crop in value, and it, too, finds a ready market at good prices. Oats and wheat are also grown, but it is doubtful if there is much profit in them, especially the latter. Many farmers say that the only reason they grow wheat is in order to seed the land to grass again. Potatoes bring excellent prices and the markets are convenient, but although they yield well few are grown except for home use. In some localities blight has proved destructive, in others it is unknown, and wherever spraying has been practiced it has given little or no trouble.

A number of farmers located near trolley or railroad lines strive to supply the city demands for dairy products. Many of them ship their milk to Pittsburg to commission men, getting from 12 to 15 cents a gallon in summer and 20 cents in winter for milk testing 3 per cent butter fat. The milk is then retailed at 32 cents a gallon.

Near some of the larger cities in those sections where natural gas is available the greenhouse industry is springing up. The gas is used for fuel, and vegetable forcing is proving a remunerative occupation.

Both the Westmoreland and the Brooke soils found in the area are well adapted to general farming. The Westmoreland silt loam, the prevailing type in the area, will produce excellent yields of corn, oats, wheat, and grass. Good bluegrass pasture may also be secured on it, the bluegrass coming in as the timothy dies out. On some of the steeper slopes of the Westmoreland silt loam and on the Steep broken land (Westmoreland material) these bluegrass pastures have remained for 30 or 40 years. Certain phases of the soil are also particularly adapted to orcharding and berry growing, while the Westmoreland fine sandy loam is well suited to the growing of early truck.

The Brooke soils, although difficult to handle properly, are excellent corn soils and particularly adapted to use as bluegrass pastures. Clover and timothy will not last so long on these soils and the bluegrass comes in the second or third year and grows very luxuriantly. It is upon the Brooke and the Westmoreland soils closely associated with them that the dairy and live-stock interests are most extensively developed. The dairy industry especially has proved very profitable on these soils, but inaccessibility to market, the confining nature of the work, and the difficulty in securing competent labor have prevented it from becoming as extensive as it otherwise would.

Good stands of alfalfa have been obtained on both the Brooke silt loam and the Westmoreland silt loam, where proper care has been used in preparing, liming, and inoculating the seed bed.

The Elk silt loam, while not of large extent in this area, seems well adapted to the growing of vegetables, particularly tomatoes and potatoes.

The Huntington silt loam is also well adapted to general farm crops, especially corn, while it produces excellent truck. Intensive agriculture could well be applied to this type in growing such crops as cabbage, celery, cauliflower, onions, etc., for which the demand is very great.

The rotation usually practiced is corn, oats, and winter wheat each one year, followed by grass, which is allowed to stand for from three to six years. The wheat is sown with timothy in the fall and clover in the spring. The result is a stand of grass in which clover predominates the first year and timothy the following year, after which bluegrass appears in increasing amounts yearly. When there is no longer sufficient timothy to make it profitable to cut for hay, the field furnishes a good bluegrass pasture for a year or so before being planted to corn again. When potatoes are grown they generally take the place of corn in the rotation and usually the potato patch occupies a small corner of the cornfield.

In some instances corn is grown for two successive years, and the rotation is then the same as the previous one. This practice can profitably be pursued only on very level areas, as on the steeper slopes the effects of erosion, especially the second year, would be too injurious. The first year the rotting sod holds the soil and prevents serious washing, but the second year the sod is decomposed to such an extent that it no longer does this.

Some farmers endeavor to overcome this difficulty by disk ing the corn stubble in the fall and sowing to rye, which may be plowed under in the spring. This practice seems commendable, because it furnishes a cover crop to protect the ground from washing and adds some organic matter to the soil when plowed under in the spring. In order to give good results, though, the rye must be plowed down before it gets too tall (preferably when knee-high), otherwise injurious effects will be experienced, particularly in a dry season.

A few farmers have abandoned the growing of wheat altogether, claiming that it is impossible to grow it profitably. They are using a rotation of corn, oats, and grass. Timothy and clover are seeded in front of the drill with the oats, which is not sown too thickly, and usually a very good stand of grass is obtained. Two crops of clover are secured the following year. The principal difficulty encountered in using this rotation seems to be that if the oats are too thick or lodge the young grass is smothered out. The advocates of this method

claim, however, that a good catch of grass will be secured four years out of five and the unprofitable growing of wheat eliminated.

The greater amount of stock kept on the dairy farms invariably manifests itself in the increased productiveness of the soil. While the amount of live stock kept on the farm has increased in late years, no doubt more stock could be kept to good advantage. If the crops were fed on the farm and marketed in the form of dairy products or fat stock, and the manure applied to the land, the productiveness of the soil would be greatly increased.

Some commercial fertilizers are used throughout the area, but many of the farmers have discontinued their use, claiming that no beneficial results are obtained commensurate with the expense incurred. This may be due in a large degree to the fact that as a rule the farmers have paid little or no attention to the analysis of the fertilizer used, buying whatever the fertilizer agent suggested. When fertilizer is used it is generally applied on the wheat or corn at the rate of from 150 to 200 pounds per acre.

Lime is beginning to be applied by increasing numbers of farmers, and always with beneficial results. Up to within the last few years little liming had been done for a long time. The amounts now applied range between 500 to 2,000 pounds per acre, and it is believed best to use this once every rotation. The lime is generally applied to the land prepared for corn or wheat. Many farmers are making the mistake of spreading the lime on the sod and plowing it under, whereas better results are obtained by spreading it upon the plowed ground and harrowing it in.

One of the greatest difficulties experienced in the area is the prevention of destructive erosion. On the steep hillsides, especially where a cultivated crop is being grown, a hard rain will in some places wash large gullies, and in other places compact the soil greatly. The difficulty may be obviated in several ways. One of the most common is to allow strips of sod or grain several feet wide to run at intervals around the hill with the contours. Another method is to run "water furrows" in the field which carry the water away on an incline too gentle to admit of very serious washing. The rows of corn are also planted with the contours. After the corn crop has been removed it is advisable to sow some cover crop to protect the soil during the winter. Crimson clover has been tried, but with little success in getting a catch. Rye may be used advantageously. A few farmers have used cowpeas and soy beans for green manuring and have had moderate success. This practice has not been general, as the price of seed seems to deter many.

The farmers throughout the area are quite prosperous, owing no doubt, in some degree, to the money obtained from the sale of coal, oil, and gas rights. The farmhouses are generally comfortable and

the barns are of a substantial nature. Good horses are the rule in the county, and considerable horse breeding is done in some sections. The cattle kept are generally grades, although purebred Holstein, Jersey, Angus, and Shorthorn herds are scattered through the county. The sheep still kept in the area are mostly of the wool types—Delaines or Merinos. They will yield from 6 to 7 pounds of wool per sheep annually. The wool sells at from 25 to 35 cents a pound. Taking the cost of feed into consideration it is doubtful whether this is profitable and whether it would not be better to raise a mutton type of sheep for the Pittsburg market. This is being done in a few instances, and it is said that the extra price paid for the lambs more than compensates for the greater amount and better quality of wool obtained from the wool breeds. Some farmers keep sheep merely as an aid in maintaining soil fertility, and feel satisfied if the income pays for their maintenance.

Although the steepness of some of the hills precludes the use of farm machinery, more up-to-date machinery is being used every year.

The labor problem is a serious one in some sections. A great many of the young men have left the country for the city and mining towns, being attracted by the higher wages and shorter hours. The foreign labor which is sometimes secured is, moreover, incompetent and inefficient. Day labor cost from \$1.25 to \$2 a day, and the monthly wage ranges from \$25 to \$35 a month, in addition to which a house and appurtenances are furnished. Most of the farmers try to arrange their work so that as little hired labor as possible will be needed.

Farms vary in size from 80 to 300 acres, although a few holdings are larger. The average size is about 130 acres. About 80 per cent of the farms are operated by the owners, the remainder by tenants on either a cash or a share basis, or a combination of both.

The last six or eight years has seen a rapid increase in the value of farm lands. Good farms within a few miles of Washington, with only fair improvements, are held at from \$150 to \$200 an acre, while in the more remote parts of the county the same grade of land can be bought for \$60 an acre. These prices refer only to the surface, the coal, oil, and gas rights being reserved. The value of land is affected to a large extent by its topography also, the steeper slopes being less desirable because of the difficulty in preventing erosion.

In Washington County the damage done by coke smoke has not been nearly so serious as elsewhere in southwestern Pennsylvania. Along the Monongahela River and Tenmile Creek are the only coke ovens, and while in the immediate vicinity of these ovens the vegetation has been killed, the smoke generally follows the valleys, and the damage does not extend beyond the ridges which separate that valley from the next. As the coal development increases dam-

age from this source may become greater, but at the present time it has not affected the agriculture of the county to any great extent.

In a few places in the county the removal of veins of coal near the surface has caused "cave-ins" and a decrease in the soil moisture, and so reduced the value of the land for farming purposes. Such areas, however, are small and few in number. In most cases the coal veins lie so deep that the soil moisture is unaffected by their removal. There seems to be no definite rule as to the depth at which coal may be removed without injury to the surface. It depends almost entirely on the character of the overlying rock formations.

The agriculture of the area might be improved by employing methods calculated to increase the productiveness of the soil and by adapting a type of agriculture to meet the exceptional markets and demands so near at hand.

The increase in soil productiveness could in many instances be brought about in several ways. The soils of practically the entire county show unmistakable signs of acidity. The inability of many farmers to obtain a "catch" of clover during recent years has been traced directly to this cause. This acidity may readily be corrected by the use of lime. Limestone may in most instances be obtained from the home farm and, owing to the cheapness of coal, burned on the farm at a very moderate expense. Applications of lime at the rate of from 2,000 to 3,000 pounds per acre once in every rotation would not prove excessive.

The humus content in the soil is as a rule low throughout the area. Organic matter should be added by the heavy application of barnyard manure and by the plowing under of green crops, preferably legumes, such as clover and cowpeas. The soils should also be protected during the winter by cover crops. Deeper plowing and more thorough preparation of the seed bed is needed in a great many instances. The keeping of a larger number of live stock on the farm and the use of their manure would also tend to increase the productivity of the soil.

With the exceptional markets and transportation facilities of the area, there are vast possibilities opened up for the growing of special food products. The market demand is very broad. Well-to-do families in Pittsburg will pay fancy prices for high-class products, and the large laboring class employed in the various industries require an enormous amount of good, substantial food, of which the common vegetables compose the greater part.

Potatoes, cabbage, tomatoes, large and small fruits of all kinds, and high-class dairy products could all be produced easily on the various soils of the area, and the market demand for them is very great.

## SOILS.

The soils of the area may be classified on the basis of their formation into three general groups: (1) The upland residual soils, (2) terrace soils or former alluvial deposits, and (3) bottom-land soils or recent alluvial deposits. Each one of these groups is represented by one or more different types.

The upland residual soils have been derived, geologically speaking, from the Coal Measures of the Carboniferous period. The formations here represented are the Monongahela and the Dunkard group, which includes the Washington and the Green formations. These formations are the result of the deposition of sediments in an interior sea, which was intermittently subsiding, and consist of horizontal strata of sandstone and shale, with interbedded limestone and beds of coal.

After the period of subsidence, during which these deposits were made, there occurred a period of elevation. In this area very little folding of the rock strata resulted during this process of elevation, and as a result the sediments, lying in practically horizontal layers, became a land area and were subjected to the forces of weathering and erosion.

The effect of these forces has been to remove, on one hilltop, strata of shale and sandstone and expose a limestone, while on another hill of different elevation the shale and limestone will have been weathered away and a strata of shale or sandstone exposed. On the hillsides occurs a soil derived from the weathering of the horizontal strata of shale, sandstone, and limestone. The residual soils therefore fall naturally into two divisions or series: (1) The Westmoreland series, including those soils of shale, sandstone, and limestone derivation, and (2) the Brooke series, including those soils of limestone or predominatingly limestone derivation. Each of these series is represented by several types of soil, which differ among themselves in texture, topography, and agricultural value.

Where the shales, fine-grained sandstone, and their interbedded limestones have weathered, there occurs the Westmoreland silt loam, while where the coarser-grained sandstones have been exposed, the fine sandy loam of the same series occurs. These soils are well adapted to corn, oats, grass, fruit, and truck.

The Brooke soils occur on those hilltops, plateaus, and ridges where erosion has exposed a limestone. These soils are well adapted to general farm crops, but particularly to bluegrass.

The second of the three general groups of soil—the terrace soils—is found most extensively along the Monongahela River, in the form of high terraces. Small areas also occur along Tenmile, Chartiers, and Raccoon Creeks, in like topographical positions.

The material consists of silts overlying fine sands and gravel to varying depths. Different theories have been proposed to account for these deposits. M. R. Campbell advances the theory that the waters were raised locally by temporary ice dams at various points and that the sediments were deposited in the resultant ponds and lakes. Whatever theory may be accepted, there is little doubt that these materials were deposited at a time when the water level of the streams was considerably higher and had but little current, and the subsequent deepening of the stream channel has left the sediments upon elevated rock benches.

But one type of soil represents this general division—the Elk silt loam.

The third of the general groups of soil found in this area has also but one representative soil type, the Huntington silt loam. It occurs along the stream courses in narrow strips, and has been formed as a result of the deposition of fine material by the quieter currents of the various streams. These bottom lands are in most instances quite narrow, and along the smaller streams they are so restricted that it is impossible to show them on a map of this scale. The largest body of this soil is found along Chartiers Creek. Much or all of this type is subject to overflow in times of high water. The texture varies somewhat, but is predominately a silt loam.

The following table gives the name and the actual and relative extent of the different soil types:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Westmoreland silt loam.....	488,192		Elk silt loam.....	2,432	0.4
Sandy subsoil phase.....	512	85.8	Rough stony land.....	1,664	.3
Steep broken land (Westmoreland material).....	51,520	9.0	Westmoreland fine sandy loam	960	.2
Huntington silt loam.....	12,224	2.2	Westmoreland stony loam.....	832	.2
Brooke silt loam.....	7,616	1.3	Total.....	569,600	-----
Brooke clay loam.....	3,648	.6			

**WESTMORELAND SILT LOAM.**

The surface soil of the Westmoreland silt loam is a brown or yellowish-brown to grayish-brown silt loam ranging in depth from 7 to 12 inches. The soil is mellow and very friable and contains a high percentage of silt, although frequently considerable fine sand is found. The subsoil is a yellowish-brown to yellow silty clay loam to silty clay, generally becoming somewhat heavier in texture and lighter in color with increase in depth. Sometimes the soil is very silty to a depth of 15 inches, but below that it usually grades into

a compact silty clay loam or silty clay. The subsoil is occasionally mottled with red, brown or gray, and has a characteristic greasy or soapy feel when pressed between the fingers.

On the steeper slopes and sharp peaks the surface soil is shallow, and quantities of shale, sandstone, and occasionally limestone fragments are found scattered through both the surface and subsoil. These fragments, however, are not of sufficient number to interfere with cultivation and on the more level areas of the type are frequently lacking altogether. Small flakes of mica, coming from the fine-grained micaceous sandstone from which the type is partially derived, are also found in both the surface and the subsoil.

The type is easily handled, but erodes very readily, and care must be exercised to prevent this on the steep slopes. If plowed when too wet the soil shows a tendency to clod, bake, and puddle, but this can easily be prevented by proper handling.

This is the predominating type in the county and covers by far the greater part of the whole area. It is derived from shales, sandstones, and interbedded limestones of the Monongahela and Dunkard formations.

The predominating parent rocks have been the argillaceous shales and fine-grained sandstones. These are, however, interstratified with limestone and calcareous shale, the layers ranging from an inch to several feet in thickness. Where these limestones outcrop on a slope there will frequently be a small band of Brooke silt loam or Brooke clay loam a few feet in width.

The topography of this type ranges from rolling to quite steep, and its agricultural value is affected to a marked degree by the steepness of the topography, inasmuch as clean cultivated crops can not be grown on the steeper hills without danger of eroding the soil badly.

This type is well drained, except in localities where the horizontal position of the underlying rock strata has prevented downward percolation and has given rise to seepage areas a few rods in extent.

The native vegetation consists of oak, hickory, locust, black gum, maple, and beech. Most of the timber has been or is rapidly being cut away. Such areas are growing up with scrub oak and blackberry thickets.

The Westmoreland silt loam is well adapted to all the general farm crops, while the lighter phases give excellent yields of potatoes and truck. Fruit growing is also profitable on this type. Hay is perhaps the crop most grown and yields 1 to  $3\frac{1}{2}$  tons per acre, averaging  $1\frac{1}{2}$  tons. Corn yields 30 to 80 bushels, averaging 40 bushels. Oats yield 25 to 65 bushels, averaging 40 bushels per acre. Wheat yields 12 to 30 bushels, averaging 18 bushels. While very few

potatoes are raised except for home consumption, yields of 200 bushels per acre have been secured, and there is little doubt that this yield could be increased with careful handling. Tomatoes also do well, and the growing of such truck is advisable. The wide range and the low average of yields on this type are due to the fact that but few farmers throughout the area are getting the maximum possible returns.

The rotation usually practiced is corn, oats, and wheat, followed by grass for hay and pasture for from three to six years. Most of the farmers try to keep their land in grass as long as possible, for two reasons: (1) It is the easiest crop to grow, and (2) it prevents destructive erosion. Instead of increasing the fertility of the land by this method, as many think, the productiveness is generally decreased, because no manure or fertilizer is applied to the grass as a top dressing, and the greater part of the hay is sold off the farm. Considerable damage is also done by pasturing the grass stubble closely and by stock tramping the soil and young plants badly in wet weather.

If the land is to be left in grass for a number of years, it should be top-dressed with a good application of barnyard manure immediately after harvesting, or an application of commercial fertilizer should be made upon the meadow in the spring as soon as it begins to show green. An application giving good results is 150 pounds of nitrate of soda, 150 pounds of acid phosphate, and 50 pounds of muriate of potash per acre. The fertilizer will increase the stand of plants and the thickened sod when plowed under for corn will increase the yield of that crop.

A few farmers have used commercial fertilizer on this type, principally with the wheat and oats, but little or no regard has been paid to the analysis of the fertilizer, and so the results obtained are negative. The majority of the farmers are prejudiced against the use of fertilizers.

In the growing of corn and potatoes, especially on the steeper slopes of this type, contouring and terracing should be practiced to prevent washing. Cover crops of rye, vetch and rye, or crimson clover might also be used to protect the ground during the winter and then plowed under in the spring to furnish additional organic matter.

By far the greater part of this soil type shows signs of acidity and a deficiency of humus. Where lime has been applied to correct the acidity, valuable results have been obtained. Applications of from 1 to  $1\frac{1}{2}$  tons per acre should be made, and the best place in the rotation to apply this seems to be on the ground plowed for corn or wheat, one or two weeks before seeding.

The humus content of the soil can be raised by the plowing under of green crops, or the application of barnyard manure. If more

stock were kept on this type, the roughage fed on the farm, and the manure applied to the land, the humus content, and consequently the productiveness of the soil, would be greatly increased.

The Westmoreland silt loam is well adapted to apples, peaches, plums, cherries, and berries, and where there is no damage from coke smoke and likely to be none for some years to come, orcharding would no doubt prove a profitable occupation. Peaches do especially well on that phase of the soil having a lighter subsoil and containing numerous shale and sandstone fragments. The Elberta, Crawford, and Carmen are the principal varieties raised at present. The varieties of apples that are giving the best results are the Rome Beauty, Jonathan, Gano, Wealthy, Baldwin, Northern Spy, and Grimes Golden. The tops of the ridges and higher slopes afford the better locations for orchards because of better air drainage, and consequently less damage from frost.

Outcrops of carboniferous shale sometimes occur in this type. They give rise to a heavy black loam or silty clay loam having a subsoil of much the same texture but growing lighter in color with depth.

Such areas sometimes occupy as much as an acre and are locally known as "coal blossoms." They very often show signs of acidity, and generally yield less than the surrounding Westmoreland silt loam. Their productiveness seems to depend on the degree of acidity and the amount of carbonaceous matter present.

*Sandy subsoil phase.*—In the southwestern part of the area, a phase of this type occurs differing somewhat from the typical Westmoreland silt loam. The surface soil is a light-brown silt loam, but the subsoil ranges from a yellow silty clay loam to a silty sandy clay, and at a depth of 30 inches is often a yellowish sand or sandy loam, resting upon the decomposing rock. The soil seems to be derived almost entirely from a brown or grayish-brown sandstone, although limestone is found in such close proximity that it is possible that it has had some influence upon the soil formation.

This phase occupies plateaulike areas and tops of hills where erosion has brought this coarser grained sandstone near the surface. It seems somewhat less productive and inclined to be more droughty than the typical Westmoreland silt loam. The phase is indicated upon the map by crosslining. The area largest in extent occurs at what is known as "Sandy Plains," west of Fredericktown.

#### WESTMORELAND FINE SANDY LOAM.

The soil of the Westmoreland fine sandy loam is a brown to yellowish brown heavy fine sandy loam to loam about 8 inches in depth.

The subsoil from 8 to 30 inches in depth is somewhat lighter in color than the surface soil and ranges in texture from a heavy fine sandy loam to a sandy silt loam containing considerable clay.

The type is a residual soil derived from the weathering of a gray, fine-grained, micaceous sandstone, and fragments of the sandstone are scattered through both the soil and subsoil. It occupies the tops of hills and ridges and plateau-like areas where the parent rock has been exposed by weathering. The subsoil is light and easily worked, and can be plowed earlier in the spring than any of the other types in this area. Its topographic position and the light texture of the subsoil, however, are such as to make drainage excessive and the soil is inclined to be droughty.

Nearly all of this type is at present under cultivation, a growth of chestnut and some oak having previously been removed. The greater part of the type is used in general farming and the same rotation is employed as upon the Westmoreland silt loam, except that the land is not as a rule left in grass for more than one year. The reason for this is that neither timothy nor clover lasts long on this soil and the bluegrass does not come in as the timothy dies out. If the land is left in grass for more than one year sorrel crowds out whatever stand of timothy there may be.

Corn yields from 25 to 50 bushels per acre, oats from 20 to 40 bushels, and wheat from 10 to 15 bushels. Grass will not yield more than 1 ton of hay to the acre.

Owing to the earliness with which the soil may be worked in the spring it would seem well adapted to the growing of early truck. Little of the type is used for this at the present time, however. Some peaches are grown on this soil and produce well, and its topographic position offers good sites for orcharding.

Very little commercial fertilizer is used on this type, the farmers saying that it leaches away too rapidly to make its use profitable. Heavy applications of barnyard manure seem to be the best means of maintaining humus in the soil, but the effect of the manure is not felt for a great length of time, owing to the open nature of the subsoil and consequent rapid oxidation of the organic matter.

Lime has not been applied to this type on account of this leaching tendency also, but there is little doubt that applications of from 500 to 1,000 pounds would prove beneficial, as the soil shows signs of acidity.

This soil type has a small area and the agricultural conditions of the county are not affected to any great degree by it. It commands a price of from \$20 to \$30 an acre less than the adjoining areas of the Westmoreland silt loam.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

*Mechanical analyses of Westmoreland fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
25079.....	Soil.....	0.6	1.4	1.6	18.8	20.8	43.8	12.5
25080.....	Subsoil.....	.5	3.6	4.9	34.1	21.8	24.0	10.5

**WESTMORELAND STONY LOAM.**

The surface soil of the Westmoreland stony loam is a light-brown loam or silty loam, 8 to 10 inches in depth, containing a large quantity of sandstone fragments, from one-half inch to 2 inches in diameter. The subsoil is somewhat lighter in color than the surface soil and contains a higher percentage of clay, grading into a silty clay loam. The subsoil also contains numerous sandstone fragments, and generally rests upon the disintegrating rock formation at from 2 to 3 feet below the surface.

It is a residual type derived from the weathering of the more resistant sandstones, and occupies the tops of narrow ridges and sharp peaks of hills, where erosion has exposed the sandstones and where the rate of erosion keeps close pace with weathering, and so prevents the formation of a deep soil. Limestone is often found closely associated with this type.

The numerous shale and sandstone fragments make the soil somewhat more difficult to cultivate than the Westmoreland silt loam, and in conjunction with the topographic position of the soil give excellent drainage. In dry seasons it is inclined to be droughty. This type was formerly covered with a growth of oak, hickory, and considerable chestnut, but much of the first growth has been removed, and it now supports a second growth of the same species or is under cultivation.

The special adaptation of the soil seems to be to peaches, and some of the best peach orchards in the area are on this type. The Alberta and Early and Late Crawford varieties are the ones principally grown. This soil grows good crops of oats and wheat, giving a grain of good quality, but not so great a growth of straw, and the grain is not so likely to lodge. Owing to the droughty tendency of the type it is not so well adapted to corn, although it gives excellent yields in favorable seasons. Corn yields from 50 to 80 bushels per acre, largely depending on the rainfall. Oats will yield from 20 to 40 bushels, averaging 25 bushels. The hay crop also

depends on the season to a large extent, often being "burned out" in excessively dry weather. Yields of from 1 to 2 tons per acre are secured.

On account of the porous nature of this soil, the effect of commercial fertilizers does not last long and little is used. The main soil deficiencies seem to be organic matter and lime. This may be remedied by the liberal application of barnyard manure and the plowing under of such crops as cowpeas, clover, rye, and vetch, and by using lime at the rate of 1,000 to 2,000 pounds per acre every four or five years. Deep plowing would also be of benefit to this type, and the soil should always be protected during the winter months by cover crops.

The type is of limited extent in the county and occurs only in small areas, so that no great amount of it is found on any one farm. Its topographic position makes it suitable for orcharding and it would seem better to use it for this than for general farming. This type is locally known as "channery land."

#### STEEP BROKEN LAND (WESTMORELAND MATERIAL).

The surface soil of the Steep broken land (Westmoreland material) is a light-brown silt loam, averaging about 4 or 5 inches in depth. The subsoil is a silty clay loam, yellow or yellowish-brown in color. Both the surface and the subsoil contain a great number of shale, sandstone, and occasionally limestone fragments. In many cases these are so numerous that it is impossible to bore into the soil more than a few inches. The underlying rock generally lying close to the surface (from 15 to 20 inches) and on the steeper slopes rock outcrops often occur. When these are so numerous that cultivation would be impossible the area has been mapped as Rough stony land.

This type occurs throughout the area, principally along stream courses and is most largely developed in West Finley Township, along the Monongahela River and Kings Creek.

It is a residual soil derived mainly from the weathering of the soft shales, fine-grained sandstones, and thin-bedded limestones of the Dunkard group, and is therefore Westmoreland in origin. It occupies those slopes which are so steep that no attempt at cropping them should be made.

The content of the shale and rock fragments and the steep broken topography of the type combine to separate it from the Westmoreland silt loam. Seepage areas are frequent, and where vegetation has not protected the soil it has been badly eroded. Landslides are also common, and on a very steep slope a series of shelf-like terraces often result.

While crops might be grown on the type, and sometimes are, in those sections where good land is scarce the topography is such that they must be sown and gathered by hand. Owing to this fact and to

the damage done by erosion, where cropping is attempted, very little of the type is under cultivation. Where cultivation has been attempted the field generally has to be abandoned after the first year because the rains and weathering influences have reduced the humus content and removed much of the surface soil itself.

Much of the type has a growth of hardwood timber upon it. In other places this has been removed and blackberry thickets have grown up, while around the heads of drainage channels, where the type sometimes occurs, thickets of locust trees are found.

The type is better adapted to pasture than anything else. Good bluegrass pastures affording excellent grazing and remaining for 20 or 30 years may be secured on these slopes. It is typical grazing land for sheep and goats, and where protection from dogs may be had it could profitably be used for this purpose.

Some of the land in the vicinity of towns has been utilized by the recent foreign immigrants for small vineyards and they secure good yields of grapes of a fair quality. Apple orchards might be set on some of the less steep slopes, but the areas available for this purpose would be small and it would be necessary to keep cover crops upon the soil at all times to prevent erosion.

#### ROUGH STONY LAND.

The areas of Rough stony land in this county occur principally along the Monongahela River bluffs and the lower slopes of the narrow valleys of the smaller streams.

While derived from the same geological formations as the Steep broken land (Westmoreland material), this type differs from it in steepness of topography, depth of soil, and the number of rock outcrops. Frequently the steep bluffs are bare rock walls, while on the less steep slopes there is a thin layer of silty soil interspersed with numerous sandstone and occasional limestone outcrops. This silty surface soil is the result of the weathering of the interbedded finer grained sandstones and soft shales. The subsoil usually contains considerable clay.

Landslides are common on this type, in some cases moving a few feet, and in others, starting at the top and continuing to the bottom of the bluff. They often remove all the soil to the underlying rock. These conditions make the type so rough, uneven, and steep that in many cases not even a stand of grass can be maintained.

In Mount Pleasant Township a few areas of Rough stony land occur that differ somewhat from that already described. The soil is a light-brown silt loam growing heavier with depth, but on account of the numerous sandstone fragments it is seldom possible to bore more than 8 or 10 inches. The topography is not particularly steep, but there are so many huge blocks and boulders of sandstone that

cultivation would be impossible. These sandstone blocks and outcrops are from 3 to 8 feet in height and of like dimensions in depth and breadth.

The natural vegetation of the Rough stony land is oak, hickory, and maple. Nearly all of the type is wooded, although some of it is with second growth.

The type can not be considered of any great value agriculturally. There are small areas occurring between the terraces and rock outcrops that might be tilled by hand, but as a whole it should be left in forest, as it is not even desirable for grazing purposes.

This type occupies so small a percentage of the Washington County area that it does not affect the value of the land or agricultural conditions to any great extent.

#### BROOKE SILT LOAM.

The soil is a light-brown silt loam from 8 to 10 inches deep, very mellow and friable, and occasionally contains a few small shale fragments, although this is not a necessary characteristic of the type. The subsoil is a heavy, very tenacious clay varying in color from a light brown or a reddish brown to a dark chocolate. At depths of 18 to 24 inches it occasionally becomes a drab or a dark brown mottled with gray.

The surface soil contains perhaps a little more clay than the Westmoreland silt loam, but is quite similar. The subsoil is very different both in texture and color. When dry the soil plows and works up very satisfactorily, but if plowed when too wet it clods and puddles, and in places where the surface soil is shallow there is danger of forming a hardpan. The type occupies the tops of hills and plateau areas where limestone and perhaps the overlying strata of shale have weathered into a silt loam surface soil, while the underlying limestone has given rise to the heavy tenacious clay subsoil.

The soil occurs principally in connection with the thick-bedded limestones of the Monongahela formation, but is also found where one of the thicker limestones of the Dunkard group has been exposed to weathering agencies. It is closely associated with the Brooke clay loam and the two types are frequently intermixed. The most extensive development of this soil occurs in Independence, Chartiers, Cross Creek, and Mount Pleasant Townships.

The Brooke silt loam is one of the strongest and most productive soils in the area, easily cultivated, and not requiring so much care in tilling as the Brooke clay loam. It was one of the soils earliest cleared for agricultural purposes, and practically all of it is at present under cultivation. It was formerly covered with a growth of hardwood.

The nature of the subsoil makes this type very retentive of moisture, and it is superior to the Westmoreland silt loam in this respect.

This is a very noticeable feature in dry seasons. On account of its moisture holding capacity it is the best corn soil in the area. Yields of 60 to 100 bushels per acre may be secured with good handling. The oat crop grows very rank on this type, and there is a tendency for it to produce too much straw and too little grain. Yields of from 30 to 60 bushels per acre are secured, and the average is about 40 bushels. Wheat yields from 18 to 30 bushels per acre, averaging about 20 bushels. The soil seems very well adapted to grass, especially clover, and yields of  $1\frac{1}{2}$  to  $3\frac{1}{2}$  tons of hay per acre are secured. The second year, when the proportion of timothy is greater, the yield is generally not so heavy and it decreases still more the third year, by which time bluegrass has largely superseded both timothy and clover. The bluegrass, which furnishes excellent pasture, grows thicker in succeeding years, and will occupy the land a long time.

The six-year rotation of corn, oats, and wheat, each one year, followed by grass for hay two years, and for pasture one year, is the common one on this type. Some of the best farmers keep their land in grass for hay a year or so longer by using top dressings of stable manure.

This soil seems to be less acid than those of the Westmoreland series, but it responds readily to applications of lime, and better results are secured where it has been used. The best results have been obtained where lime has been applied at the rate of about 1 ton or  $1\frac{1}{2}$  tons to the acre, and harrowed into the surface soil when being prepared for wheat.

Some commercial fertilizer has been used with this soil, principally with the wheat and corn, but as a rule no attention has been paid to the grade used. In several instances, however, farmers have found that the best results obtained were when 200 pounds of acid phosphate per acre were applied.

It is upon this type and the Westmoreland silt loam closely associated with it that the dairy interests are most largely developed. In these sections more live stock is kept and the value of feeding the produce on the farm and applying the manure is evidenced by the increased productiveness of the farms.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

*Mechanical analyses of Brooke silt loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
25073.....	Soil.....	0.4	1.1	1.3	5.8	4.3	63.9	22.8
25074.....	Subsoil.....	.0	.3	.3	1.5	2.1	50.5	45.2

## BROOKE CLAY LOAM.

The soil of the Brooke clay loam is a dark-brown or reddish-brown heavy clay loam or clay about 8 inches in depth. Fragments of bluish-gray limestone and calcareous shale are frequently found scattered through the soil. From 8 to 36 inches the soil grows heavier and is a dark-brown or chocolate-colored, tenacious, heavy clay, frequently containing gray mottlings.

This is a very strong soil if handled carefully and tilled at the right time, but it requires very cautious treatment, for if plowed when either too wet or too dry the soil will clod, puddle, and bake so badly that crops will be a total failure. When plowed with just the right moisture content the soil breaks up into a good seed bed. There is a common saying that this type "should be plowed just one day in the year."

The soil occurs throughout the county on hilltops, ridges, gentle slopes, and plateau areas where limestone and calcareous shales have been exposed by erosion and weathered into soil. The type is of limestone origin and derivation almost entirely, and is most extensively developed in Independence, Chartiers, Mount Pleasant, Cross Creek, and Robinson Townships, in connection with the thick-bedded limestones of the Monongahela formation. It is also found, however, where the limestones of the Dunkard group outcrop.

While the topographic position of the type affords good drainage, the nature of the soil is such as to prevent this being excessive. If it has been plowed and cultivated in the proper condition it will absorb sufficient moisture in the spring to carry crops through very dry seasons. On the other hand, when improperly tilled, evaporation will be so rapid and the soil will bake so badly that crop failure will result.

The native vegetation was hardwood, oak and hickory principally, but nearly all of this has been removed and practically the whole type is under cultivation.

This is a typical corn and bluegrass soil. Oats and wheat also do well, but there is a tendency toward too much stalk, and, although this is generally strong enough to support the heads of the grain, the growth is likely to be so thick that winds and storms cause it to lodge. A wide range of yields of the various crops are obtained, variation in management and in wet or dry seasons being responsible for the differences.

Corn will yield from 40 to 90 bushels per acre, oats from 20 to 60 bushels, and wheat from 15 to 25 bushels. Grass yields heavily, from 1½ to 3 tons per acre, but it will last only a short time. Bluegrass comes in early and makes a very heavy growth, resulting in excellent

pasture, which persists for many years. For this reason much of the type is in pasture. Injury to pasture is frequently caused by allowing live stock on it in very wet weather.

The soil is too heavy for truck, potatoes, or small fruits, and while some varieties of apples might do well, the type as a whole is not adapted to fruit.

The farmers have learned how to handle the soil intelligently and to advantage, but the stress of work and the seasonal conditions frequently prevent this. The best method is believed to be to plow the soil in the fall or early in the spring, so that it will be frozen and thus pulverized. The great objection to fall plowing is that it leaves the ground unprotected during the winter, and damage from erosion frequently results.

Very little commercial fertilizer has been used on this type, and nothing that has been applied seems to give the permanent beneficial results that barnyard manure does. Besides furnishing plant food, it improves the physical condition of the soil.

As a rule no lime is used on this type, the farmers being under the impression that a limestone soil has no need of lime. In a few instances where lime has been applied it has been found that light applications give better results than heavy ones, and they have improved the catch of clover and also the physical condition of the soil. In a few places alfalfa has been tried on this type with indifferent success. Fall seeding seems to have given the best results.

This type and the Brooke silt loam, closely associated with it, have an important influence on the agricultural conditions of the county. Not only are they strong productive soils, but being located on the hilltops, the influence of the limestones from which they are derived is felt upon the surrounding Westmoreland soils, making them more productive.

On account of the difficulty in handling the Brooke clay loam, and because of the excellent grazing it furnishes, much of the type is in pasture, and the live-stock and the dairy interests of the county are most extensively developed in those sections where this soil is found.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Brooke clay loam:

*Mechanical analyses of Brooke clay loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium. sand.	Fine sand.	Very fine sand.	Silt.	Clay.
25075.....	Soil.....	0.0	0.3	0.4	3.4	3.0	55.5	37.0
25076.....	Subsoil.....	.2	.5	.3	1.3	1.6	46.3	49.4

**ELK SILT LOAM.**

The soil of the Elk silt loam is a light-brown or yellowish-brown mellow silt loam from 10 to 12 inches in depth. It is very friable and often contains some very fine sand.

The subsoil to a depth of 36 inches is a brown or yellowish-brown silt loam or silty clay loam. It is often quite compact, and at depths of 18 to 24 inches thin strata of fine sand or fine sandy clay are occasionally encountered. At depths of from 3 to 5 feet or more, deposits of sand and waterworn gravel are found. Some waterworn gravel is sometimes found throughout the soil and subsoil. The soil is easily worked and productive.

The soil occupies second-terrace positions along the Monongahela River and its tributaries. The terraces along the Monongahela River lie from 100 to 200 feet above the present channel of the river, and in some instances occupy shelf-like positions on the river bluffs. Along Tenmile and Chartiers Creeks the soil occupies like topographic positions, but the terraces are not nearly so high-above the stream bed.

The soil is derived from alluvial deposits laid down at some previous time when the water level of the stream was higher than at present. Subsequent deepening of the stream channels has left these deposits on elevated rock benches, and weathering and erosion have in many instances changed their topography from level to rolling. In the latter event, more fine sand is likely to be found in the soil.

The type as a whole is well drained, on account of its topographical position and of the underlying strata of sand and gravel. Where it occurs in a shelf-like position or at the base of hills, small areas where drainage water collects sometimes occur, and these are likely to be poorly drained. In these localities the subsoil is likely to be somewhat mottled with gray.

The Elk silt loam does not occur in this county in areas sufficiently large to affect the agriculture of the county to any appreciable extent. The fact that most such areas occur along the Monongahela River, where industrial activities greatly overshadow agricultural pursuits, has rendered it difficult to ascertain the agricultural possibilities of the type. Much of it is not under cultivation, but is built up with the dwellings of miners and those employed in the various mills and mines along the river. It appears to be a fairly strong soil, but in need of organic matter.

Some corn is produced on the type, and yields from 40 to 70 bushels per acre. Wheat yields from 10 to 18 bushels per acre, and oats from 25 to 40 bushels. The soil is not so well adapted to grass as the other soils of the area, and yields of  $1\frac{1}{2}$  tons per acre are considered good. Potatoes do well on this type, but suffer from lack of

moisture in dry seasons. Yields of 175 bushels per acre have been secured.

Most of the type under cultivation is used for general farming, and the usual rotation of corn, oats, wheat, and grass is employed. Owing to its nearness to the markets along the Monongahela River, where there is a great demand for such food products, and on account of the apparent suitability of the soil for the purpose, it would seem advisable to grow garden truck on this type. Tomatoes and cabbage do well, and blackberries, raspberries, and strawberries should prove excellent crops.

#### HUNTINGTON SILT LOAM.

The soil of the Huntington silt loam, to a depth of 12 inches, is a brown to dark-brown silt loam, with a high percentage of clay. The surface soil is somewhat variable in texture, and often contains numerous small flakes of mica.

The subsoil is a heavy silt loam to silty clay loam, dark brown in color, except in some places where drainage is poor and organic matter abundant, where it is apt to be much darker. There is no distinct line of demarcation between the soil and subsoil, the change in texture and color being so gradual as to be imperceptible except at the extremes, where the subsoil appears lighter in color and heavier in texture than the surface soil. Sometimes at the depth of 24 to 30 inches a stratum of fine sand or sandy clay will be found.

The soil puddles readily if plowed when wet, and care should be taken to avoid this. When dry it works up very friable and mellow.

The Huntington silt loam occupies the first bottoms of the stream courses throughout this area. It is in no place very wide, but occurs in narrow strips in the bends and curves of the streams as they meander back and forth in the valleys. The topography is level to flat, and occasionally small level areas occur where artificial drainage would be necessary, but the type as a whole has sufficient slope toward the stream to give good drainage.

The soil was formed by the deposition of the finer material in quiet waters at times of flood, together with the material washed from the adjoining hills and deposited in the valley floors. It is subject to overflow annually, more especially during the early spring. During the later months, after planting season, there is little danger. There are many places where the process of formation of this soil still continues. At each period of overflow a layer of material is deposited along the stream banks, while each hard rain brings a quantity of wash from the neighboring uplands.

The type was originally covered with a growth of hardwood trees, but these have long since been removed, as this was one of the first soils cleared for farm use, and is considered one of the strongest

soils in the area. Where trees are left standing they are usually of the water-loving varieties, such as the willow, sycamore, beech, and birch.

The soil is especially well suited to the growing of corn, its topographic position being such that it will have a good supply of moisture even in very dry seasons. Corn will yield from 50 to 90 bushels per acre, with an average of about 65 bushels. Hay is also a very good crop on this type, and yields from 1 ton to  $2\frac{1}{2}$  tons per acre. Bluegrass, however, does not thrive so well on this soil as on the Brooke soils, and although the type is often used for pasture, it is more on account of its proximity to running water than for any other reason. Better yields of oats than of wheat are secured, but this type is not considered especially adapted to these crops. The former yield from 25 to 60 bushels and the latter from 12 to 20 bushels per acre. Potatoes do excellently upon this soil, and it could be more extensively used for this crop. With care and proper handling, yields of 200 bushels to the acre could be secured.

As on the other soils of the area commercial fertilizer is used principally with wheat, when used at all. There is believed to be less need for fertilizer on this type than on any other, owing to the constant upbuilding of the soil by frequent overflows. Weeds are likely to be troublesome on this type, because of the deposition of weed seeds with the other material at such times.

This type is being used in the vicinity of a number of towns for the growing of truck crops, and excellent results are being obtained where overflow can be prevented. In many cases this can be accomplished by cleaning out the stream channel or erecting a small levee, while in other places even this is unnecessary, as after the first early spring freshets there is no likelihood of damage by flood. The soil produces excellent cabbage, cauliflower, tomatoes, and lettuce. Celery also does well. As there is an excellent market for these products, it is believed that this type could profitably be used more extensively for this purpose.

This soil is considered one of the most fertile and productive of the whole area, and brings from \$125 to \$200 per acre, depending on its proximity to towns, etc.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Huntington silt loam:

*Mechanical analyses of Huntington silt loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
25077.....	Soil.....	0.4	1.4	3.0	5.4	6.7	62.0	20.7
25078.....	Subsoil.....	.0	.1	.3	4.2	15.2	50.3	29.4

## SUMMARY.

Washington County is located in southwestern Pennsylvania, adjoining the northern part of the Panhandle of West Virginia. In a north and south direction the area is about 36 miles long, while from east to west it varies from 36 miles in the south to 12 miles in the extreme north. It contains 569,600 acres, or 890 square miles.

The Monongahela River forms most of the eastern boundary, and from the steep bluffs which border it the county ranges westward in rolling or hilly uplands. The county embraces the divide between the Monongahela and the Ohio Valleys, the eastern part of the county being drained into the former and the western part into the latter river. The valleys are narrow, but generally wide enough to have some bottom land along the streams. The hills bordering the stream channels are rather steep, and become more abrupt as the streams increase in size.

The county is unusually well supplied with transportation facilities by branches of the Baltimore & Ohio and Pennsylvania railroads and the electric lines of the Pittsburg Railway Co. Considerable traffic is also carried on by way of the Monongahela River.

The climate is moderate. While the winters are cold, they are not extremely severe, and the summers are moderate and pleasant. The precipitation amounts to about 40 inches annually, and is well distributed throughout the year, the greater amounts coming at that time during the growing season when the crops need it most.

The farming population, which comprises about 50 per cent of the total population of the county, is descended, in the main, from the early settlers who came from eastern Pennsylvania, Virginia, and Maryland. The remaining 50 per cent consist of trades people and those interested in the industrial development of the county.

The average size of the farms is about 135 acres, and about 80 per cent are operated by their owners. The farms are not, as a rule, operated to the full extent of their possibilities. Farm labor commands good wages, and the scarcity of competent labor is a handicap to agricultural development.

The farm improvements are of a high class, considerable up-to-date farm machinery is used, and the live stock kept on the farm is of a high standard. A great many sheep are still kept in the area, although the wool industry has decreased greatly in the last decade or so. The farmers are a thrifty, wide-awake class, but the sale of the coal, oil, and gas rights has brought them considerable wealth and caused many of them to neglect their farms.

Washington, the county seat, in the central part of the county, is the principal town in the area. Other prominent towns are Charleroi, Monongahela, and California, situated along the Monongahela

River, Claysville in the southwestern part, and Canonsburg, McDonald, and Burgettstown in the north.

Nine soil types, including Rough stony land and Steep broken land (Westmoreland material), were found in the area. The Westmoreland silt loam, the predominating soil in the county, is the most important type. It is well adapted to all the general farm crops, while certain phases produce excellent potatoes, truck, and fruit. The Westmoreland fine sandy loam, though not of great extent, should prove an excellent soil for the production of truck. The Westmoreland stony loam is a good soil for peaches, and also gives good yields of the general farm crops.

The Steep broken land (Westmoreland material) and Rough stony land are best left in pasture or in timber.

The Brooke silt loam is the strongest soil found in the area. It is well adapted to all the general farm crops and to the growing of bluegrass pastures. The Brooke clay loam is also a strong type, but requires very careful handling to get good results. It is especially adapted to the growing of corn and bluegrass, and upon it and the Brooke silt loam the dairy and live-stock interests of the area are most extensively developed.

The Elk silt loam has a small area and a great part of it is not under cultivation, but used for town sites and building purposes. It seems adapted to the production of tomatoes and potatoes and gives good yields of the general farm crops.

The Huntington silt loam is well adapted to corn, and where damage from overflow can be prevented it is especially good for the growing of truck crops. Oats and grass also yield well.

The soils throughout the area, especially the upland types, are in general deficient in two respects. They are acid and low in organic matter. The organic content of the soils may be raised either by the application of barnyard manure in large quantities or by the plowing under of green crops, preferably legumes of some kind. Lime-stone is at hand for burning and lands may be cheaply limed.

Aside from the improvement of the soil productivity by correcting these deficiencies, the agriculture of the area would be benefited if more attention were paid to supplying the demand of the near-by markets for special food products.

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